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PREFACE

Preface

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This issue of JOTA is published in honor of one of the leaders in our field, Professor Emeritus Elijah Polak—or "Lucien" as he is known among friends and colleagues. With an issue of 17 papers written by 43 international experts, we celebrate his 85th birthday August 11, 2016. It is a distinct pleasure and honor to dedicate this issue to my advisor, mentor, collaborator, friend, and ski instructor(!), Lucien Polak.

Lucien was born in Poland in 1931 and grew up amidst the horrors of the Second World War. He survived several concentration camps and after the war eventually made it to France where he and his mother, the sole survivors of their family, embarked for Australia. After an interlude of several years, Lucien continued his education and received a Bachelor degree from the University of Melbourne in 1957. In 1959 and 1961, he was awarded Master and Doctoral degrees from the University of California, Berkeley. He immediately joined the faculty of the Department of Electrical Engineering at Berkeley where he was to spend his whole career.

1 A Pioneer in Control and Optimization

Lucien has contributed immensely to the areas of unconstrained and constrained optimization, nonsmooth analysis, especially, minimax and semiinfinite programming, as well as optimal control. He has published nearly 300 articles, reports, and books, including two widely known monographs (1971 and 1997). Throughout his career, JOTA has been a preferred outlet for his relentless energy. He has published no less than 34 papers in JOTA across the period 1974–2010, covering nearly the whole history of the journal. He has advised more than 30 graduate students. He was a Guggenheim Fellow in 1968–1969 at the Institut Blaise Pascal in Paris, France, and

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a United Kingdom Science Research Council Senior Postdoctoral Fellow at Imperial College, London, England, in 1972, 1976, 1979, 1982, 1985, 1988, and 1990. He is a Life Fellow of the Institute of Electrical and Electronic Engineers (IEEE), a member of the Society of Industrial and Applied Mathematics (SIAM) as well as the Mathematical Optimization Society.

Lucien's version of the method of conjugate directions [10] is still among the preferred algorithms for large-scale unconstrained optimization. The Polak-He Phase I-Phase II algorithm [4] is a competitive alternative for difficult constrained problems arising, for example, after discretization of optimal control problems. Lucien developed a general framework for quantifying near-optimality through optimality functions. In particular, for semiinfinite programs and optimal control problems, optimality functions lead to new optimality conditions that facilitate precision-adjustment tests in algorithms.

Lucien pioneered the distinction between conceptual and implementable algorithms, and dedicated much of his career to eliminating conceptual steps and developing automatic parameter adjustment rules in numerous contexts. His deep thinking about the construction of numerical methods, often viewed as set-valued mappings, helped clarify the difference between algorithm implementation, where conceptual steps in an algorithm are approximated, and consistent approximations, where the optimization problem is approximated and analyzed through epi-convergence. In fact, going beyond epi-convergence of optimization problems, which establishes the convergence of optimal solutions, Lucien considered hypo-convergence of the corresponding optimality functions and thereby ensured convergence of stationary points as well.

Lucien remains remarkably active with recent efforts centered on important applications of game theory to harbor defense scenarios. Despite his mathematical prowess, he pays close attention to needs in applications and modeling. In 2014, he enlisted midshipmen at the US Naval Academy in war games, where future Navy officers tried to outsmart Lucien's real-time harbor defense algorithm, which later was also tested in field experiments.

2 A Personal Tribute

As a student of Lucien, all my early training in optimization is due to him, including the spelling of "optimization," which I ignorantly wrote as "optimalization" before our first meeting. His perspective on approximations of optimization problems influenced me profoundly. I benefited tremendously from his insistence on rigor; any hand-waving argument was wisely dismissed as "rubbish." Lucien advised with the whole student in mind, dispensing guidance about "slower is faster," places to shop, and even recipes for ratatouille. His explanation of optimal control started with the question "do you have a girlfriend?" followed by a description of a suitor that would like to optimally steer a boat to his date on the dock. It has been a tremendous experience to know Lucien and I am much honored to be the Guest Editor of this special issue.

3 Description of Issue

The first nine papers of the issue deal with control, a subject central to Lucien's career. D.Q. Mayne and P. Falugi provide new stabilizing conditions for model predictive control. M.A. El-Gebeily et al. examine a new class of optimal control problems involving nonlinear self-adjoint operator equations. Q. Gong et al. give foundations for spectral collocation methods on arbitrary grids. Y. Jiang et al. examine the minimal time function for semilinear control systems. W. Hager et al. establish rates of convergence of Gauss collocation methods. R. Boucher et al. develop a framework for Galerkin optimal control. A. Festa and R.B. Vinter derive a decomposition technique for a class of zero-sum differential games. C. Yu et al. examine transformations of time-delayed optimal control problems. O. Pironneau and M. Lauriere address a stochastic control problem for resource management. The next two papers examine stability of optimization problems. M.J. Canovas et al. develop specific formula for subdifferentials and calmness moduli in linear and nonlinear programming. A. Shapiro derives stability results for metric projections onto convex sets. The following two papers address optimality conditions. J.O. Royset and R. Wets examine optimality functions using lopsided convergence. X. Yang et al. give optimality conditions for semi-infinite programs by means of exact penalization. The next two papers deal with decomposition methods. Y. Cui et al. revisit the alternating direction method. B. O'Donoghue et al. solve large-scale conic programs using operator splitting. The paper ends with Y. Song and L. Qi developing results on tensor complementary problems and with O. Stein and P. Kirst utilizing generalized semi-infinite programming to address disjunctive optimization problems.

4 Biography of Elijah Polak

Elijah (Lucien) Polak was born August 11, 1931 in Bialystok, Poland. He is a Holocaust survivor and a veteran of the death camps at Dachau, Auschwitz, Gross Rosen, and Buchenwald. Although his father perished in the camps, his mother survived. After the War, he worked as an apprentice blacksmith in Poland and a clothes salesman in France. In 1949, he and his mother migrated to Australia, where, after an eight year interruption, he resumed his education, while working various part time jobs. Elijah Polak received the B.S. degree in Electrical Engineering from the University of Melbourne, Australia, in 1957 and the M.S. and Ph.D. degrees, both in Electrical Engineering, from the University of California, Berkeley, in 1959 and 1961, respectively. In 1961 he married Virginia (Ginette) Gray with whom he had a son and a daughter. At present, they have 5 grandchildren, the oldest of whom graduated with a triple major degree in physics, mathematics and computer science. From 1957 to 1958 he was employed as an Instrument Engineer by Imperial Chemical Industries, Australia and New Zealand, Ltd., in Melbourne, Australia. He spent the summers of 1959 and 1960 as a Summer Student, with I.B.M. Research Laboratories, San Jose, California, and the Fall Semester of 1964 as a Visiting Assistant Professor at the Massachusetts Institute of Technology. Since 1961, he has been on the faculty of the University of California, Berkeley, where he is at present Professor Emeritus of Electrical Engi-

neering and Computer Sciences. He was a Guggenheim Fellow in 1968–1969, at the Institut Blaise Pascal, in Paris, France, and a United Kingdom Science Research Council Senior Post Doctoral Fellow, at Imperial College, London, England, in 1972, in 1976, in 1979, in 1982, 1985, 1988, and in 1990. His research interests lie in the development of optimization algorithms for computer-aided design, with applications to electronic circuit design, control system design, and structural design, as well as algorithms for optimal control and nonsmooth optimization. Most recently, he has concentrated on applications in search, evasion, and pursuit. He has even developed algorithms for tuning pacemakers. Professor Polak is the author or co-author about 300 papers as well as of four books: Theory of Mathematical Programming and Optimal Control (with [1]), Notes of a First Course on Linear Systems (with E. Wong, 1970), Computational Methods in Optimization (1971), and Optimization: Algorithms and Consistent Approximations (1997). In addition, with L.A. Zadeh, he co-edited System Theory (1969), and translated from the Russian Absolute Stability of Regulator Systems, by M.A. Aizerman and F.R. Gantmacher. He is a Life Fellow of the Institute of Electrical and Electronic Engineers, a member of the Society of Industrial and Applied Mathematics and a member of the Mathematical Programming Society.

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